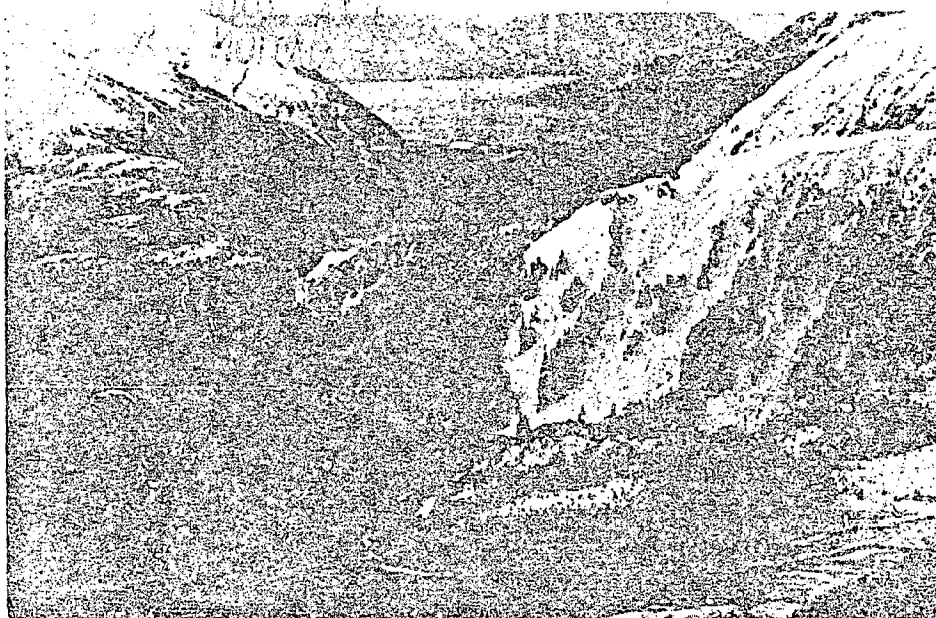


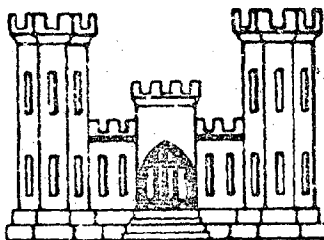
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NATIONAL SHORELINE STUDY



INVENTORY REPORT
ALASKA REGION



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U.S. ARMY CORPS OF ENGINEERS
NORTH PACIFIC DIVISION

AUGUST 1971

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27 September 1971

SUBJECT: National Shoreline Study, Inventory Report, Alaska Region

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The inclosed 12 copies of "National Shoreline Study, Inventory Report, Alaska Region," dated August 1971, are being furnished in accordance with C3,AR 70-31. This report presents an inventory of areas of serious erosion, ownership, and use of the ocean and estuary shorelines of the State of Alaska, and is approved for public release; distribution unlimited.

FOR THE DISTRICT ENGINEER:

Incl (12)
as

Warren George
WARREN GEORGE
Chief, Engineering Division

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The National Shoreline Study

How will the shore be used ?



SHORE MANAGEMENT GUIDELINES

What is its condition ?



REGIONAL INVENTORY REPORTS

What can be done ?

to preserve or enhance the shore,
by using—

- Engineering techniques



**SHORE PROTECTION GUIDELINES
REGIONAL INVENTORY REPORTS**

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Management techniques



SHORE MANAGEMENT GUIDELINES

In 1968, the 90th Congress authorized this National appraisal of shore erosion and shore protection needs. This National Shoreline Study and the existing Federal shore protection programs recognize beach and shore erosion as problems for all levels of government and all citizens. To satisfy the purposes of the authorizing legislation, a family of 12 related reports has been published. All are available to concerned individuals and organizations in and out of government.

→ REGIONAL INVENTORY REPORTS (one for each of the 9 major drainage areas) assess the nature and extent of erosion; develop conceptual plans for needed shore protection; develop general order-of-magnitude estimates of cost for the selected shore protection; and identify shore owners.

→ SHORE PROTECTION GUIDELINES describe typical erosion control measures and present examples of shore protection facilities, and present criteria for planning shore protection programs.

→ SHORE MANAGEMENT GUIDELINES provide information to assist decision makers to develop and implement shore management programs.

→ REPORT ON THE NATIONAL SHORELINE STUDY, addressed to the Congress, summarizes the findings of the study and recommends priorities among serious problem areas for action to stop erosion.

NATIONAL SHORELINE STUDY

INVENTORY REPORT

ALASKA REGION

U.S. ARMY CORPS OF ENGINEERS

North Pacific Division
210 Custom House
Portland, Oregon 97209

Alaska District
P.O. Box 7002
Anchorage, Alaska 99510

August 1971

NATIONAL SHORELINE STUDY

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NATIONAL SHORELINE STUDY
ALASKA REGION INVENTORY REPORT

INTRODUCTION

1. AUTHORITY

This report was prepared under the authority of Section 106 of the 1968 Rivers and Harbors Act (Public Law 90-483) approved 13 August 1968 and quoted below:

"SEC. 106. (a) The Chief of Engineers, Department of the Army, under the direction of the Secretary of the Army, shall make an appraisal investigation and study, including a review of any previous relevant studies and reports, of the Atlantic, Gulf, and Pacific coasts of the United States, the coasts of Puerto Rico and the Virgin Islands, and the shorelines of the Great Lakes, including estuaries and bays thereof, for the purpose of (1) determining areas along such coasts and shorelines where significant erosion occurs; (2) identifying those areas where erosion presents a serious problem because the rate of erosion, considered in conjunction with economic, industrial, recreational, agricultural, navigational, demographic, ecological, and other relevant factors, indicates that action to halt such erosion may be justified; (3) describing generally the most suitable type of remedial action for those areas that have a serious erosion problem; (4) providing preliminary cost estimates for such remedial action; (5) recommending priorities among the serious problem areas for action to stop erosion; (6) providing State and local authorities with information and recommendations to assist the creation and implementation of State and local coast and shoreline erosion programs; (7) developing recommended guidelines for land use regulation in coastal areas taking into consideration all relevant factors; and (8) identifying coastal areas where title uncertainty exists. The Secretary of the Army shall submit to the Congress as soon as practicable, but not later than 3 years after the date of enactment of this Act, the results of such appraisal investigation and study, together with his recommendations. The views of concerned local, State, and Federal authorities and interests will be taken into account in making such appraisal investigation and study."

2. PURPOSE

The National Shoreline Study provides an overall comprehensive assessment of the beach and shore erosion problems confronting the Nation. The study is not intended to, and does not, develop specific projects for the protection of beaches and shores. It does, however, develop the information essential to assess the nature and extent of erosion problems and to formulate possible remedial action.

3. SCOPE

The National Shoreline study is broken into three classes: Shore Erosion Inventories; Shore Protection Guidelines; and Shore Management Guidelines. A separate report has been prepared for each of these classes.

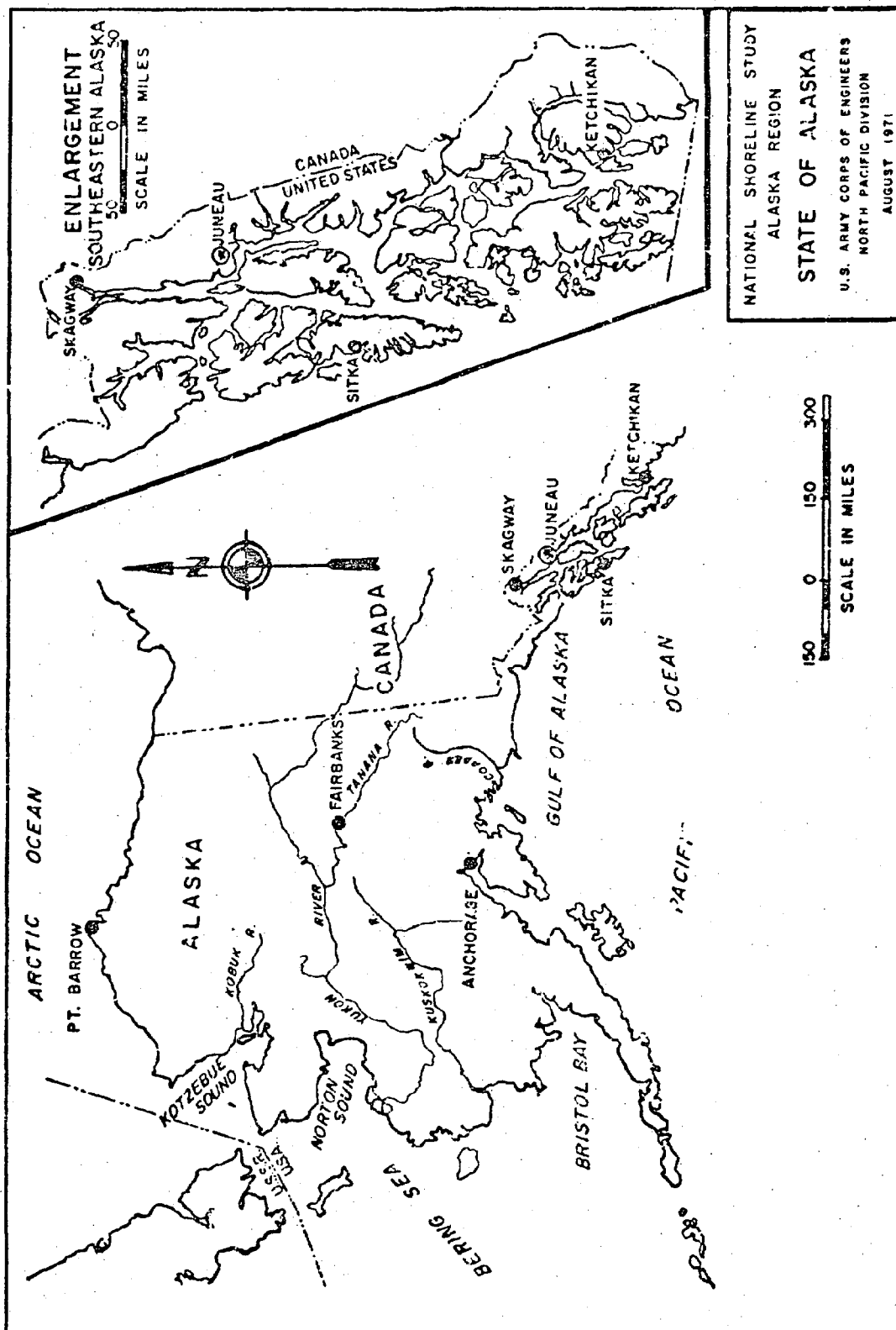
This report presents an inventory of the physical characteristics, historical changes, and ownership and use of the coastal shorelines of the states including major bays and estuaries. The historic changes studied relate to erosion produced by wave and tidal phenomenon. The reports on protection guidelines and management guidelines were prepared and published by the Coastal Engineering Research Center, Corps of Engineers, and the Office, Chief of Engineers, respectively. The protection guidelines report presents typical protective structures, general design criteria, typical cost estimates for various areas, and examples of shore protection projects. The management guidelines report includes reference material on multiple uses of the shore, principles of comprehensive planning, zoning, insurance, and other nonstructural alternatives. A summary report submitted to Congress summarizes the regional inventories and estimates of cost for erosion control measures and recommends categories of priorities and broad national goals and objectives of long-range comprehensive planning for the shoreline.

Because of its remoteness from the continental United States, the State of Alaska was designated as a separate region, intitled the Alaska Region. The Regional Inventory Report emphasis is on problem identification, with the ocean shoreline and estuary shoreline discussed under four general categories, namely: physical characteristics; historical shore changes; shore ownership; and shore use. The purpose of the study is identification of those areas of serious erosion, considered in conjunction with economic, industrial, recreational, agricultural, navigational, and other relevant factors. Because approximately 99% of Alaska's 47,300 miles of coastline¹ is virgin land with thousands of miles still unexplored and with the time and monetary limitations imposed for the study, a complete documentation of erosion areas on Alaska's shoreline is impossible. Therefore, this report discusses the entire coastline of Alaska in general terms with detailed coastline information presented only for the developed areas. Areas of erosion were determined primarily from reports received from State and local agencies, from requests by local interests for assistance in alleviating erosion problems, from studies and surveillance programs conducted by the Corps of Engineers, and from study of aerial photographs.

4. COORDINATION

Letters were sent to all Federal, State, and local governments, groups, and individuals known to have interest in the shoreline, requesting

¹ All coastline mileages used in this report were obtained by map scaling the coastline to the head of tidewater.



NATIONAL SHORELINE STUDY

ALASKA REGION

STATE OF ALASKA

U.S. ARMY CORPS OF ENGINEERS
NORTH PACIFIC DIVISION

AUGUST 1971

PLATE 1

their assistance in quantifying the characteristics, historic changes, ownership, and use of the shoreline. Several press releases were made in attempts to involve the public. Information supplied through this coordination effort was incorporated into the inventory report.

5. DESCRIPTIVE TERMS OF SHORELINE CONFIGURATION

a. Beach. The area of unconsolidated material between the low waterline and the extreme high waterline.

b. Rocky Coast. A shoreline comprising rocky headlands with relatively no beaches. Photo No. 1 shows typical rocky coast in Alaska.

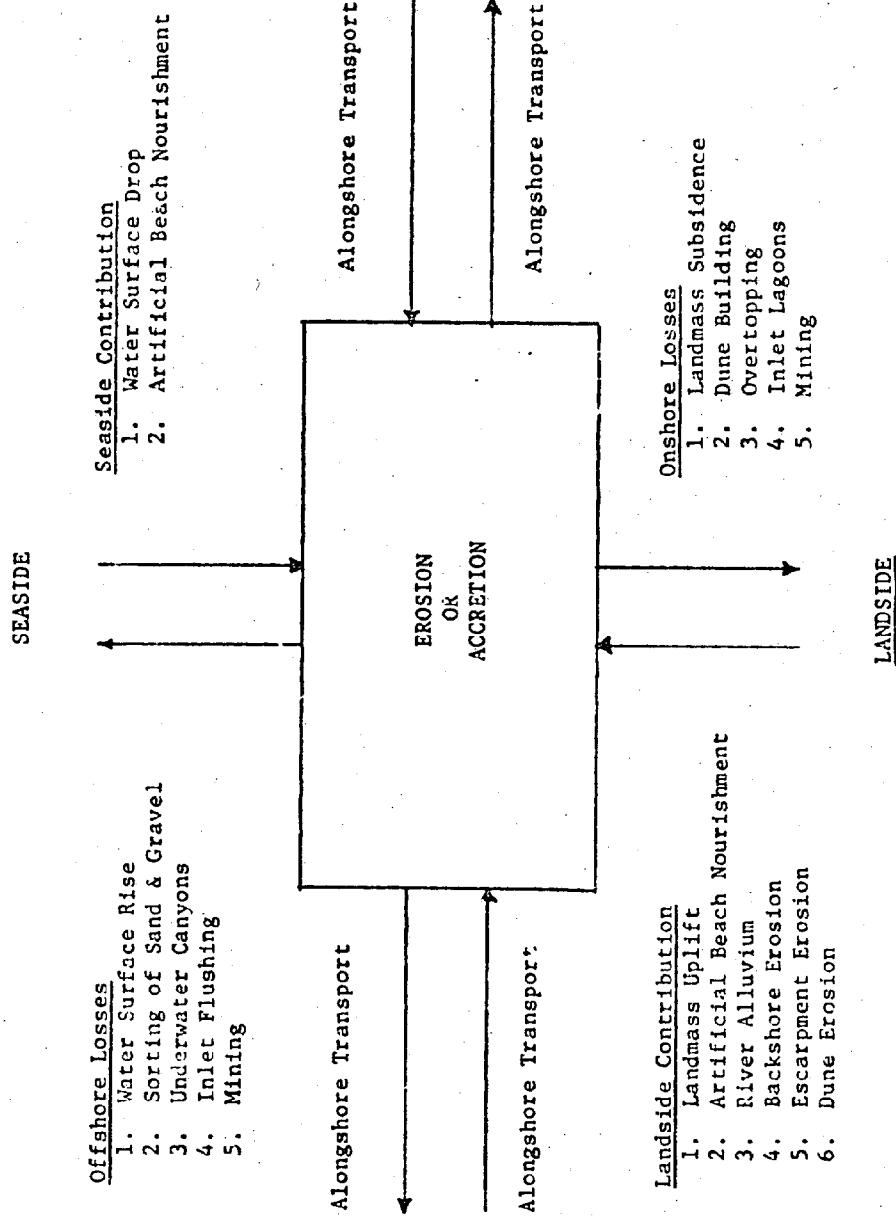
c. Estuaries or Bays. A tidal inlet formed by the mouth of a river meeting the sea.

6. EXPLANATION OF TERMS USED FOR SHORE CLASSIFICATION

a. Erosion Classification.

(1) Erosion. The wearing away of land by the action of natural forces; for the purposes of this inventory report, the carrying away of beach and upland material by wave action, tidal currents, or littoral currents. An eroding condition has more material leaving the system than is entering. Transitory changes of the Alaska shoreline occur frequently; sand beaches build up during the summer months but are stripped away during the winter. Long-term changes are often too slow to be reliably measured. Erosion of the headlands is continuous and in some instances fairly rapid, as is the seaward growth of the beaches in some localities. Because of the lack of development along much of the Alaskan shoreline, erosion has not caused a significant economic impact and little attention has been given to the problem. Very few records of volumetric changes or rates of change exist, and historical photos or charts by which comparison could be made are likewise lacking.

(2) Critical Erosion. Erosion by wave action, tidal, or littoral currents presents a serious problem because the rate of erosion, considered in conjunction with economic, industrial, recreational, agricultural, navigational, demographic, ecological, and other relevant factors indicates that action to halt such erosion may be justified. However, existing data on many of the factors are insufficient to quantify this decision. Major studies beyond the scope of the National Shoreline Study are required for definitive answers. Structural measures including seawalls, revetments, bulkheads, groin systems, and beach nourishment are usually considered for protecting the shoreline from erosion. However, structural measures taken to solve the problem in one area could transfer the problem elsewhere. Management, zoning, or acquisition of a public easement along the shoreline could be a logical means of preventing economic and other losses in some areas. These nonstructural alternatives should be investigated as part of any in-depth study of erosion areas.



FACTORS CONTRIBUTING TO SHORELINE CHANGES

FIGURE 1

(3) Noncritical Erosion. Erosion by wave action, tidal, or littoral currents does not present a serious problem because the rate of erosion in conjunction with all relevant factors indicates that structural measures may not be justified and/or that management to prevent or minimize adverse effects may be more appropriate than action to halt erosion.

(4) No Erosion. Shoreline is stable or is accreting either naturally or through the efforts of man. In a stable condition the material entering the system is equal to the material leaving the system. Any accreting condition has more material entering the system than is leaving.

b. Shore Ownership. For the purposes of this inventory report, shore ownership considers the land adjacent to and landward of the 1970 high water line. Erosion is a landward movement of this line and these ownerships are of prime importance in evaluating the relevant factors contributing to critical or noncritical erosion. Generally, the area between the low waterline and the high waterline is owned, controlled, or managed by the states. In some areas, especially in bays and estuaries, these lands have been sold or leased by the states for commercial or private purposes.

(1) Federal. Land owned by the Federal Government such as parks, wildlife refuge areas, military installations, and navigation facilities.

(2) Public (Non-Federal). Land owned by State, county, and municipal governments and port districts. These lands include parks, navigation installations, and waterway and fisherman access areas.

(3) Private. Land owned by private individuals and groups, for commercial, industrial, and residential purposes.

(c) Shore Use. Shore use in this report considers the land adjacent to and landward of the 1970 high waterline. Erosion is a landward movement of this land and use of these lands is important in evaluating the relevant factors contributing to critical or noncritical erosion.

(1) Recreational-Public. This includes public usage of Federal, State, county, and municipal parks and boat launch ramps and moorage facilities for the recreational purposes.

(2) Recreational-Private. This includes privately developed parks, resort, and moorage facilities used for recreational purposes.

(3) Non-Recreational Development. This includes all use for purposes other than recreation such as commercial, industrial, and residential developments and port and harbor facilities.

(4) Underdeveloped. This consists primarily of isolated shoreline and high bank beach front making development difficult.

7. FEDERAL PROGRAMS

The legislation establishing the existing Federal shore protection and beach restoration programs declares it to be "the policy of the United States to assist in the construction, but not the maintenance, of works for the improvement and protection against erosion by waves and currents of the shores of the United States, its territories, and possessions." In its present form, the legislation spells out the conditions for, and the extent of, Federal participation. Basically, it relates Federal participation to public benefits and requires the active participation of sponsoring local interests. Under this concept, Federal participation is greatest where the shore areas are publicly owned and appropriate facilities to encourage full public use are provided. As much as 70 percent of the construction cost can be borne by the Federal Government in such cases. Where the shore area to be protected is privately owned and there is no public use, no Federal funds can be provided. Between these extremes, Federal participation in providing protection is proportional to public use and benefit. The remaining costs are borne by the sponsoring local interests.

By various Public Laws, the Congress has directed the Chief of Engineers to carry out the policies and programs established to protect and restore the Nation's shorelines. Under these legislative authorities, the Corps of Engineers conducts research into the causes of beach erosion, investigates and studies specific beach erosion problems, and constructs shoreline protection and beach restoration projects.

Shore protection and beach restoration programs include projects specifically and individually authorized by Congress, and projects for which individual authorization by Congress is not required. The latter program is limited to projects for which the Federal share of the construction cost will not exceed \$1,000,000. These programs will be referred to as the regular project program and the small project program.

Shore protection and beach restoration projects are initiated by requests from local interests. Publicly owned shores subject to erosion are eligible for Federal assistance; privately owned shores may be eligible for Federal assistance if there is public benefit such as that arising from public use. Parties desiring information, advice, and assistance in combating beach erosion should act through and in cooperation with the State, county, or city agency concerned with beach and shore use and management. Consultation with the appropriate District or Division Engineer should then be held to explore the eligibility and applicability of Federal programs. The regular program for beach erosion studies is authorized by Congress either by a resolution approved by the Public Works Committee of the Senate or the House of Representatives or in a River and Harbor Act enacted by the Congress. If the small-project program is applicable, the Chief of Engineers can authorize the study.

Investigations and studies are made to determine whether a project is justified and, if so, whether its construction is feasible. One of the early concerns of the Engineer Officer directing the study is to ascertain the desires and opinions of all parties affected by, or having an interest in, the protection, improvement, and use of the shore area concerned. To this end, he holds public meetings and workshops during the course of the study. The study thoroughly examines the problem and alternative solutions along with the pros and cons. After careful analysis of the impacts of all applicable remedial measures on the erosion problem, other shore areas, the regimen of the coastal waters, shore processes, marine life, ecological values, and shore uses, a general plan for shore protection and beach restoration is devised. If comparisons of the costs of construction and the benefits resulting from the construction show the project to be a sound and prudent public investment, and if the local sponsoring agency affirms willingness and ability to provide the required cooperation, the report on the study recommends adoption of the project. Reports are reviewed by the Board of Engineers for Rivers and Harbors and the Chief of Engineers, and circulated for comments of the Governors of affected States, State and local agencies, and all interested Federal agencies.

As soon as a project is authorized and funded under either the regular or the small-project programs, the responsible District Engineer carries out the detailed engineering work essential to construction and prepares construction drawings and specifications. Contractors submit bids based on these drawings and specifications and a construction contract is awarded to the successful bidder. The District Engineer continues to consult and coordinate with the local sponsoring agency while engineering and construction are underway. Upon completion, the protective works are turned over to the sponsoring local interests for operation and maintenance in accordance with the existing legislation.

Further information on assistance by the Corps of Engineers in shore protection is contained in a publication, "Shore Protection Program," by the Office, Chief of Engineers, July 1970. Copies of this publication can be obtained from Division or District Engineers.

DESCRIPTION OF COASTAL AREAS

8. LITTORAL DRIFT

The Alaska current flows north and west around the Gulf of Alaska, westward along the Aleutian Islands and thence northward through the islands into Bristol Bay and along the western Alaska coast. In winter, these currents mainly turn southward around the Bering Sea, making only weak incursions into the Chukchi Sea. But in summer a strong current flows northward through Bering Strait and around northwestern Alaska to Point Barrow, where it meets a weak current flowing westward along the north coast.

9. CLASSIFICATION (PHYSICAL CHARACTERISTICS)

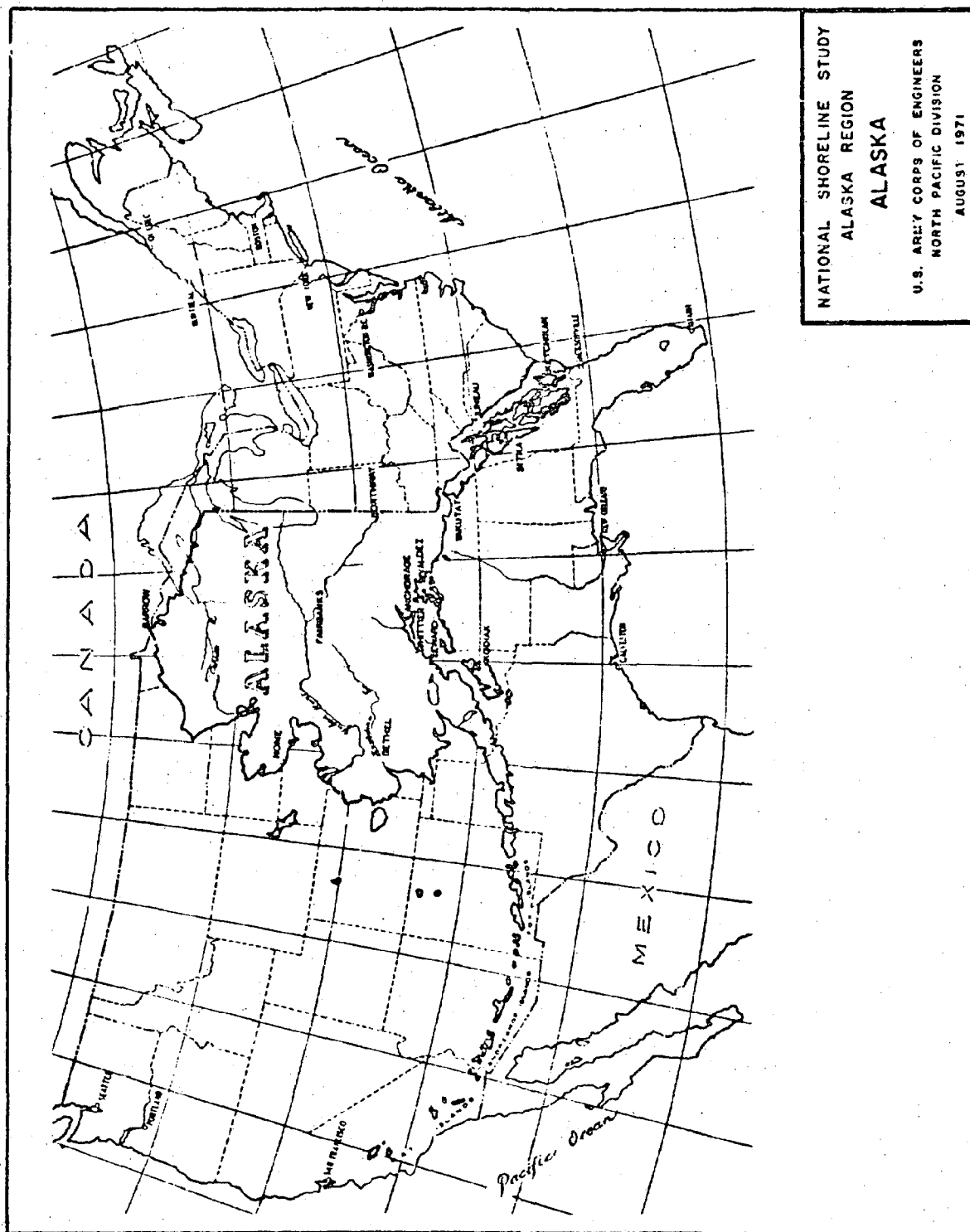
The complex coast of Alaska covers a broad geographical range in latitude and longitude and includes every type of coastal system found in the lower 49 states with the exception of the tropical area. The general coastline of Alaska is 6,640 miles long, or 54% of the total 12,383 miles of general coastline of the United States. The tidal shoreline, which includes islands, inlets, and all shoreline to the head of tidewater, is much longer and reflects the intricacy of coastal Alaska. This distance is estimated to be 47,300 miles. This tidal shoreline in Alaska is the greatest in the southeast region (63%) where the coast is a labyrinth of fiords, islands, and bays, and is minimal in the arctic. Northern Alaska land/water interfaces are predominantly earth banks behind narrow pebble beaches all along the Arctic Ocean. They range from two to three feet above sea level east of Barrow to 30 or more feet west of Wainwright. Barrier beaches occur in several localities, but they are low, without vegetation, and covered with ice during the winter. Beaches are all pebbly, and in some areas (Wainwright) soft coal is common, washed ashore from underwater seams. This land area remains frozen year-round except for the top few inches. In the Chukchi Sea and the northern Bering Sea areas, the seacoasts are still largely low gravel banks, with such areas as Point Hope extending far out into the sea. Beaches are pebbly with little or no vegetation on them. Banks behind are low, gravelly, and slope upward to the steep hills rather gradually, often for miles. The huge Yukon-Kuskokwim delta area is a vast marshy low tundra which has an indefinite coastal boundary changing with river meander movement and tide cycles. The Aleutians are solid rock, steep-sided islands with a characteristic wet-tundra vegetation found nowhere else in Alaska. The coast of the Gulf of Alaska and Kodiak Island is predominantly rocky and steep with thin soils. The Topography of southeastern Alaska was established by the Pacific Mountain system, greatly modified by the erosive action of glaciers. These coastal edges are typically rugged with flatland occurring only in short reaches at river mouths and valleys left by retreating glaciers. Of the 47,300 miles of tide-wetted coastline, 20,250 miles are classified as ocean shoreline exposure with the remaining 27,050 miles being bay or estuary shoreline exposure.

10. OWNERSHIP

Of the approximate 375 million acre land area of Alaska, 85 million acres have been withdrawn for specific purposes by the Federal Government, twelve million acres are in the process of selection by the State of Alaska, six million acres are privately owned lands, leaving 272 million acres classified as public domain land administered by the Federal Government. Of the 20,250 miles of ocean shoreline, 2,500 miles are classified public (State or city owned), 100 miles are privately owned, with the remaining 17,650 miles being Federal lands. Correspondingly, of the 27,050 miles of estuary shoreline, 3,000 miles are public, 350 miles are patented private with the remaining 23,700 miles being Federal lands. As can be seen from plate 3, the major portions of the State selected shorelines (public) are on the north slope of the Brooks Range, the north shore of the Alaska Peninsula, and the shoreline of the Gulf of Alaska. The State has also selected land areas adjacent to the major coastal cities; however, the shoreline involved totals less than 100 miles (see table 1). The privately owned shoreline exists in or near the 114 cities and villages located along the coast. This privately owned shoreline varies from zero for villages that are unincorporated and located on public domain land to 20 miles along the major cities in southeastern Alaska. Table 1 gives an estimate of private land for the shoreline settlements. The only extended length of privately owned coastline is along the east shore of Cook Inlet as shown on the insert of plate 3. At the present time, the native segment of the Alaska population is contesting the ownership of lands in the State of Alaska. Should this native land claim be settled as presently envisioned, approximately 300 additional miles of ocean shoreline and 1,500 miles of estuary shoreline could be deeded to the natives.

11. DEVELOPMENT OF COASTAL AREA (PRESENT)

Of Alaska's present population of 300,000, approximately 164,000 residents are located in the five major coastal cities of Anchorage, Ketchikan, Juneau, Kodiak, and Kenai, with 54,000 people distributed through the remaining 109 coastal cities and villages (see table 1). Except for small communities situated intermittently along the entire length, the coastline is generally devoid of habitation or capital improvement. As discussed before, many of the villages of Alaska are located on federally owned land. Coastal development consists mainly of private homes with commercial development existing in only the major cities and villages. The only shoreline development which is not city and village areas is the Cook Inlet area, along which homesteading has evolved. Plate 3 insert shows this private ownership. Of the total ocean coastline, only 180 miles are developed with the remaining being virgin coastline. Of the total estuary coastline, all is undeveloped except approximately 150 miles. (These figures do not include homestead shorelines of the Cook Inlet areas.) There are an estimated five miles of public shoreline



classified recreational which are developed as city parks in a few major cities. There are no private recreational developed areas; thus, all other developed shoreline is classified nonrecreational development.

12. FUTURE DEVELOPMENT

As Alaska continues to increase in population, many of its major cities located on glacial outwashes next to steep mountains will be compelled to expand along the coastline. With the oil, mining, and forestry industries developing in Alaska, new coastal cities may spring up in conjunction with port facility development.

SHORE HISTORY

13. NATURE OF EROSION

It is readily known that varying combinations of wind-generated waves and currents acting against an unprotected shore will result in the movement of beach materials. In Alaska, these forces are augmented by additional conditions such as extreme tidal variations (over 40 feet at Anchorage), ice (Barrow), tidal influence on river bank erosion (Kenai, Dillingham, and Bethel), and tectonic deformation. For example, the extreme tidal ranges permit wave attack on constant varying levels of a beach. Resultantly, an erosion scarp may run up and down a bluff in accordance with the tidal cycle. Such action more readily induces failure of the bluff foundation. Wind-blown icebergs in the Barrow area have inflicted considerable damage to the beaches and homes of the Barrow community. Tidal inundation of the vast flood plain of the Kuskokwim River, as far upriver as Bethel (70 miles), results in the provision of an intermittent body of water over which waves are generated. Wave impingement on the river bank fronting the community has resulted in serious bank recession and loss of improvements such as buildings and streets. Subsequent ebb of the tide permits the eroded bank material to be washed downstream by the flow of the river. Another condition which relates directly to the extent of beach erosion in Alaska is seismic deformation. Tectonic subsidence, as experienced in the Cook Inlet-Prince William Sound-Kodiak areas (see plate 4) following the March 1964 earthquake, resulted in previously unaffected shorelines being subjected to erosion processes. Anchorage, Kenai, Ninilchik, Homer, Kodiak, Old Harbor, Larsen Bay, and Karluk are communities now experiencing erosion of contiguous beaches because of tectonic subsidence varying from one to six feet. The same processes of erosion, transportation, and deposition which are found in temperate regions also occur in the arctic. Most littoral sediment is carried by longshore currents and by wave swash. Wave swash probably is the more important force because beach sediments are generally too large to be carried in suspension. However, finer sediments in suspension are carried on past spits into deep water. Ice push is not a major transport agent as it is estimated to account for only one to two percent of the total material moved. Arctic fresh water streams are small and are not an ample source of waterborne sediment for supply to ocean currents. No glaciers reach the coast as material suppliers in northwestern Alaska. Erosion of sea cliffs is also insufficient for littoral replenishment. Therefore, net transport results in depletion of shorelines to build up land forms into deeper water. Compensating for this is the effect of climate, which slows erosion, protects the coastline, and reduces longshore transport. However, one open water storm may move more sediment in a few hours than would be normally transported in 20 years. Prevailing littoral movement is northerly in northwestern Alaska and beach materials are fine. Pleistocene beach and former beach formations in the area consist of surficial coverings of unconsolidated silt, sand, and gravel deposits covering an area greater

than 26,000 square miles. This material is readily eroded and transported. Winds from easterly or westerly directions develop waves which approach beaches from the west and north which, when refracted, develop longshore currents primarily in the southeast and northeast directions. Fall storm winds from the west, developing northeasterly currents, build up points and spits to the northeast. Stormwaves and ice erode beaches with resulting sediments transported by wave swash and currents to the northeast, to build up long barrier beach bars and the westerly sides of points. Therefore, prominent shore configurations in northwestern Alaska are barrier beaches, spits, and points building up on the seaward side and slowly being extended northerly.

14. EXTENT OF EROSION

There are over 47,000 miles of coastline in Alaska which are subjected to the forces of tidal waters. The extent and degree of erosive action is a direct function of the geologic composition of the shoreline material and of the sequence and magnitude of physical forces such as wind, temperature, tidal current, and tidal stages. Of the 47,000 miles of coastline wetted by tidal waters, preliminary estimates indicate that at least 5,000 miles are exposed to significant beach erosion processes. Geologic appraisal of Alaska's coastline indicates that susceptibility to beach erosion increases with geographic latitude. Erosion along the rocky coastline of southeast Alaska has been relatively insignificant. This is also apparent along the reach of the coastline extending from Cross Sound (northern extremity of southeast Alaska) to the easterly side of the Kenai Peninsula in southcentral Alaska. For the most part, mountains and glaciers dip to meet the sea along this reach. Erosion of certain reaches of beach in the Cook Inlet area is significant due to the exposure of the high sand bluffs, sand spits, and similar shoreline materials to the direct wave and tidal attack. Specific problem areas such as Turnagain (Anchorage), Kenai, Ninilchik, and Homer are cited as examples. Proceeding along the perimeter of Alaska from Cook Inlet, problems of beach erosion become less apparent, except for isolated cases, along the southerly limits of the Alaskan Peninsula and Aleutian Chain complex: rocky shorelines predominate in this area. Along the northerly side of the peninsula and north along the entire northwesterly coast of Alaska to Barrow, more extensive erosion processes become evident. This lengthy portion of Alaska's coastline is conspicuous in its absence of coastline mountains and in the predominance of low flatlands composed of sands, silts, gravels, peat, muskeg, and permafrost. It is along this reach that the major river systems of Alaska (Yukon, Kuskokwim, Kobuk, and Noatak) meander to tidal waters. Recession of shoreline and resultant shoaling of primarily navigable coastal waters is evident throughout this reach. Specific problems are presently confronting the communities of Clarks Point, Dillingham, Bethel, Unalakleet, Nome, Shishmaref, Kotzebue, Point Hope, and Barrow. Normally, extensive erosion of the beaches north of Unalakleet would not be considered possible since the average open water season is only about three to four months each year. During the remainder



Photo 1 - TYPICAL ROCKY COAST OF SOUTHEASTERN ALASKA AND THE ALEUTIAN CHAIN



Photo 2 - TYPICAL BEACH BERM EROSION ALONG WATERFRONT IN NORTH ALASKA

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of the year, the arctic ice field covers the Norton Sound (Bering Sea)-Chukchi Sea area. Uniquely; however, sudden violent storms originating in the Bering and Chukchi Seas during the limited open water season result in direct wave impingement on the erosion-susceptible coastlines of sand and tundra.

15. CRITICAL EROSION AREAS

For eons in time beach erosion and accretion have taken place on the shoreline of Alaska. This beach movement is part of the natural cycle of the coastline. The present day-by-day beach erosion processes go unnoticed over the many miles of virgin coastline of Alaska and are only documented at the scattered coastline communities. The beach erosion classified critical in Alaska is the erosion of the shoreline along the waterfront of approximately 40 Alaska coastline communities. The native villages of Alaska, in addition to socio-economic problems, share the common problem of beach erosion. Because of former subsistence needs, native communities were sea oriented; each was built close to the beach on low-lying gravel shores; each was at the tip of a land-form spit or point where migrating marine mammals passed close to shore; and each was sited where native craft could be readily launched for the hunt. Such villages existed for thousands of years, shifting with the landform until becoming fixed by advancing civilization. Although subsistence is no longer as important as in former years, these water-oriented people cling to their ancient habitation sites, and white settlers have adopted the siting to implement the pattern. Because of advancing civilization, economic pressures, and construction of schools, coastal peoples are now deeply rooted to one habitation. Primitive villages could more easily be relocated or moved back from encroaching seas. In present times, real estate is acquired, personal possessions are many, and housing is permanent. Consequently, erosion is destroying homes and streets, public facilities, and is concurrently destroying large numbers of historic habitations. Native people are deeply disturbed by the erosive removal of their ancestral habitation sites, and although Christianized, feel a strong tribal attraction to the sites as well as hidden undercurrents of their former shamanistic religion and primitive superstitions. In addition, loss of beach berms allows storm surge to flood inland areas of villages. Waves sweep ice cakes inland to crush buildings and personal property. Salt water pollutes potable supplies with salt and sewage. As discussed in the previous section, most of these communities are endangered by natural erosion processes; however, some erosion areas are man-induced by the removal of the beach gravel. The developed property in the majority of cities and villages attacked by erosion is personal homes. These homes vary from substandard in the native villages to \$100,000 homes in the major cities. Even though home value varies, erosion encroachment on any structure is considered critical by the homeowner.

Table 1 lists villages and cities of reported erosion problems. This information was developed by questionnaire forms sent to communities. Map series 5 shows the location of these areas. Of the 330 miles of coastline classified as developed, critical erosion is estimated at 15 miles for ocean shore areas and 80 miles for estuary shoreline.

AUTHORIZED FEDERAL PROJECTS

16. DESCRIPTION AND STATUS

No Federal Beach erosion control projects have been authorized for the State of Alaska. Federal navigation projects have been authorized for the following localities in the State:

<u>Project Name</u>		<u>Status</u>
Apoon Mouth of the Yukon	Navigation Channel	Complete
Cordova Harbor	Small Boat Harbor	Complete
Craig Harbor	Small Boat Harbor	Complete
Dillingham Harbor	Small Boat Harbor	Complete
Douglas Harbor	Small Boat Harbor	Complete
Dry Pass	Navigation Channel	Complete
Egegik River	Navigation Channel	Complete
Elfin Cove	Navigation Channel	Complete
Gastineau Channel	Navigation Channel	Complete
Homer Harbor	Small Boat Harbor	Complete
Iliuliuk (Unalaska Harbor)	Navigation Channel	Complete
Juneau Harbor	Small Boat Harbor	Complete
Ketchikan Harbor	Small Boat Harbor	Complete
Kodiak Harbor	Small Boat Harbor	Complete
Metlakatla Harbor	Small Boat Harbor	Complete
Naknek River	Navigation Channel	Complete
Neva & Olga Straits	Navigation Channel	Complete
Ninilchik Harbor	Small Boat Harbor	Complete
Nome Harbor	Small Boat Harbor	Complete
Pelican Harbor	Small Boat Harbor	Complete

<u>Project Name</u> (cont)		<u>Status</u>
Petersberg Harbor	Small Boat Harbor	Complete
Port Alexander	Navigation Channel	Complete
Rocky Pass	Navigation Channel	Complete
St. Michael Canal	Navigation Channel	Complete
Rocky Pass in Keka Strait	Navigation Channel	Complete
Old Harbor	Small Boat Harbor	Complete
Anchorage Harbor	Small Boat Harbor	Complete
Seldovia Harbor	Small Boat Harbor	Complete
Seward Harbor	Small Boat Harbor	Complete
Sitka Harbor	Small Boat Harbor	Complete
Skagway Harbor	Small Boat Harbor	Complete
Stikine River	Navigation Channel	Complete
Valdez Harbor	Small Boat Harbor	Complete
Wrangell Harbor	Small Boat Harbor	Complete
Wrangell Narrows	Navigation Channel	Complete
Kake Harbor	Small Boat Harbor	Authorized
King Cove Harbor	Small Boat Harbor	Authorized
Sergius-Whitestone Narrows	Navigation Channel	Authorized

AUTHORIZED FEDERAL SURVEY STUDIES

17. DESCRIPTION AND STATUS

Formal study of the shoreline erosion problems in the State of Alaska is being conducted at the following locations:

<u>Area</u>	<u>Type Study</u>	<u>Status</u>
Dillingham	Survey Report	Active
Bethel	Survey Report	Complete (Negative)
Point Hope	Survey Report	Active
Unalakleet	Survey Report	Active
Port Lions	Recon Report	Active
Barrow	Recon Report	Complete (Negative)

IMPROVEMENT METHODS

18. GENERAL CONCEPTS

As both land erosion and aggradation are simultaneously taking place along the virgin coastline areas of Alaska, there need be little concern for this natural process. However, the encroachment of shoreline erosion in areas of developed cities and villages does cause alarm. In many areas of critical erosion adjacent to villages, the most economic measure of protection would be village relocation away from the seashore where the community would be safe from erosion or flooding. Because outlying communities are water oriented for subsistence, source of income, transportation, communication, and supply, people are not willing to move. They object quite strongly to all references to relocation, choosing to remain in their present area. Governmental agencies have been rebuffed in combined attempts to induce relocation, and are reluctant to recommend this approach. Therefore, the general concept of stabilization of the shores in their present positions, i.e., preventing further recession of those shores, should be considered.

19. SUITABLE TYPE OF REMEDIAL ACTION

As previously discussed, erosion exists from a wide variety of causes, varying from wind-driven waves and extreme tide ranges to ice flow. As can be seen, to protect the beach and bluff area in locations of high tide fluctuation and areas with severe ice induced erosion, an erosion control structure becomes very expensive. In contrast to this type of construction, there are areas where erosion could be stopped by improvement through the use of pile drum type revetment.

20. ESTIMATED COST

Cost of structural beach protection measures would depend to a great extent on the locality and the nature of the problem. Estimated cost of protection ranges from \$35/LF for barrel-type erosion protection to \$200/LF for rock riprap protection. Total cost of shoreline protection of areas having serious erosion is estimated to be 75 million dollars.

TABLE 1
ESTUARY SETTLEMENTS

City or Village	Population	Ownership Miles		Erosion Reported/Miles
		Private	Public	
Kotzebue	1,700	2-3/4	1/4	Yes*/3.0
Selawik	348	0	0	
Deering	95	0	0	No*
Brevig Mission	77	3/4	1/4	No*
Teller	217	0	0	No*
White Mountain	151	0	0	No**
Golovin	160	0	0	No*
Elim	160	0	0	No*
Koyuk	129	3/4	1/4	No*
Shaktolik	187	3/4	1/4	Yes*/1.0
Unalakleet	574	0	1/2	Yes*/1.2
St. Michael	205	0	0	Maybe*/1.0
Chaniliut	25	0	0	
Emmonak	25	3/4	1/4	
Bethel	2,500	1	1/2	Yes/1.5
Scammon Bay	115	0	0	No*
Hooper Bay	460	3/4	1/4	Maybe*/1.0
Chevak	315	0	0	No*
Newtok	150	0	0	
Toksook Bay	160	0	0	

* Contacted by letter

** Contacted by questionnaire

*** Located in a large State-selected (public) area

TABLE 1 (Cont)
ESTUARY SETTLEMENTS

City or Village	Population	Ownership Miles		Erosion Reported/Miles
		Private	Public	
Kipnak	221	0	0	
Kongiganak	344	0	0	
Tuntululiak	144	0	0	Yes**/0.5
Quinhagak	228	0	0	No*
Goodnews Bay	150	0	0	
Togiak	220	0	0	
Dillingham***	424	1-1/4	1/4	Yes/1.5
Clarks Point	138	0	0	Yes*/0.5
Ekuk	40	0	0	
Naknek	249	3/4	1/4	No*
South Naknek	150	3/4	1/4	
Egegik***	150	0	0	
Pilot Point	76	0	0	No*
Ivanof Bay	15	0	0	No*
Akhiok	25	0	0	
Uyak	10	0	0	
Larsen Bay	72	3/4	1/4	Yes*/1.0
Point Lions	190	0	0	Yes/0.5
Seldovia	460	0	0	Yes/0.5

* Contacted by letter

** Contacted by questionnaire

*** Located in a large State-selected (public) area

TABLE 1 (Cont)
ESTUARY SETTLEMENTS

City or Village	Population	Ownership Miles		Erosion Reported/Miles
		Private	Public	
Homer	1,247	20	10	Yes/20.0
Anchor Point	171	1	0	Yes/1.0
Ninilchik	169	2	0	Yes/2.0
Kenai	18,000	10	10	Yes/20.0
Salamatof	25	1/2	0	Yes/0.5
Anchorage	113,000	10	10	Yes/20.0
Eklutna***	50	0	0	
Tyonek***	187	0	0	Yes/1.0
Valdez***	1,000	5	3	
Tatitlek	96	0	0	
Cordova***	1,300	5	1/2	
Whittier	900	2	2	
Seward***	2,123	2	2	
Yakutat***	250	3/4	1/4	
Skagway***	759	5	2	
Haines***	400	5	2	
Hoonah	900	3/4	1/4	
Pelican City	135	0	1/4	
Tanakee Springs	109	0	0	
Klawock	251	3/4	1/4	

* Contacted by letter

** Contacted by questionnaire

*** Located in a large State-selected (public) area

TABLE 1 (Cont)
ESTUARY SETTLEMENTS

City or Village		Population	Ownership Miles		Erosion Reported/Miles
			Private	Public	
Kasaan	<u>S.E.</u>	36	0	0	
Hydaburg		251	1	1/4	No*
Port Heiden	<u>(Cont)</u> Bristol Bay	74	0	0	
Nelson Lagoon		25	0	0	

OCEANSHORE SETTLEMENTS

City or Village		Population	Ownership Miles		Erosion Reported/Miles
			Private	Public	
Kaktovik	<u>Arctic Slope</u>	120	3/4	1/4	No*
Nooiksut		25	0	0	
Barrow		1,314	1-3/4	1/4	Yes, serious*/2.0
Wainwright***		253	0	0	Yes*/1.0
Point Lay***		20	0	0	
Point Hope	<u>Seward Peninsula</u>	324	0	0	Yes**/2.0
Kilaliwa		142	0	0	Has seawall*
Nome		3,000	1-3/4	1/4	Yes, has seawall/0.5
Stebbins		158	0	0	No*

* Contacted by letter

** Contacted by questionnaire

*** Located in a large State-selected (public) area

TABLE 1 (Cont)
OCEANSHORE SETTLEMENTS

City or Village	Population	Ownership Miles		Erosion Reported/Miles
		Private	Public	
Shishmaref	217	0	0	Yes*/1.0
Inalik	120	0	0	
Wales	128	0	0	No**
Gambell	358	0	0	Maybe*/1.0
Savoonga	187	0	0	Yes*/1.0
Northeast Cape	20	0	0	No*
Alakanuk	278	3/4	1/4	Yes, serious*/1.0
Sheldons Point	110	0	0	
Tanunak	183	0	0	
Mekoryuk	242	0	0	Yes, serious*/2.0
Kuiglilingok	344	0	0	
Platinum	44	0	0	No*
Ungg	43	0	0	
Sand Point	254	0	0	
Belkofsky	57	0	0	
King Cove	300	3/4	1/4	
False Pass	41	0	0	
Pavloff Harbor	77	0	0	
Akutan	100	0	0	

* Contacted by letter

** Contacted by questionnaire

*** Located in a large State-selected (public) area

TABLE 1 (Cont)
OCEANSHORE SETTLEMENTS

City or Village	Population	Ownership Miles		Erosion Reported/Miles
		Private	Public	
Unalaska	400	3/4	1/4	
Nikolski	92	0	0	No*
Atka	119	0	0	No*
Biorka	20	0	0	
St. George	264	0	0	
St. Paul	378	3/4	1/4	
Perryville	111	0	0	
Chignik	99	0	0	Maybe*/1.0
Old Harbor***	193	3/4	1/4	Yes/1.0
Karluk	130	0	0	Yes*/1.0
Kodiak***	8,780	10	10	
Ouzinkie***	214	3/4	1/4	No*
English Bay***	78	0	0	
Juneau***	13,225	20	10	
Douglas***	1,152	5	5	
Angoon	395	1	1	
Sitka***	3,237	5	5	
Kake	455	1	1	

* Contacted by letter

** Contacted by questionnaire

*** Located in a large State-selected (public) area

TABLE 1 (Cont)
OCEANSHORE SETTLEMENTS

City or Village	Population	Ownership Miles		Erosion Reported/Miles
		Private	Public	
Petersburg***	2,000	10	10	
Wrangell***	1,800	2	1	
Craig***	300	1	1	
Ketchikan***	11,100	10	10	
Saxman***	153	1	1	No*
Metlakatla	1,000	5	2	No*

Southeastern

* Contacted by letter

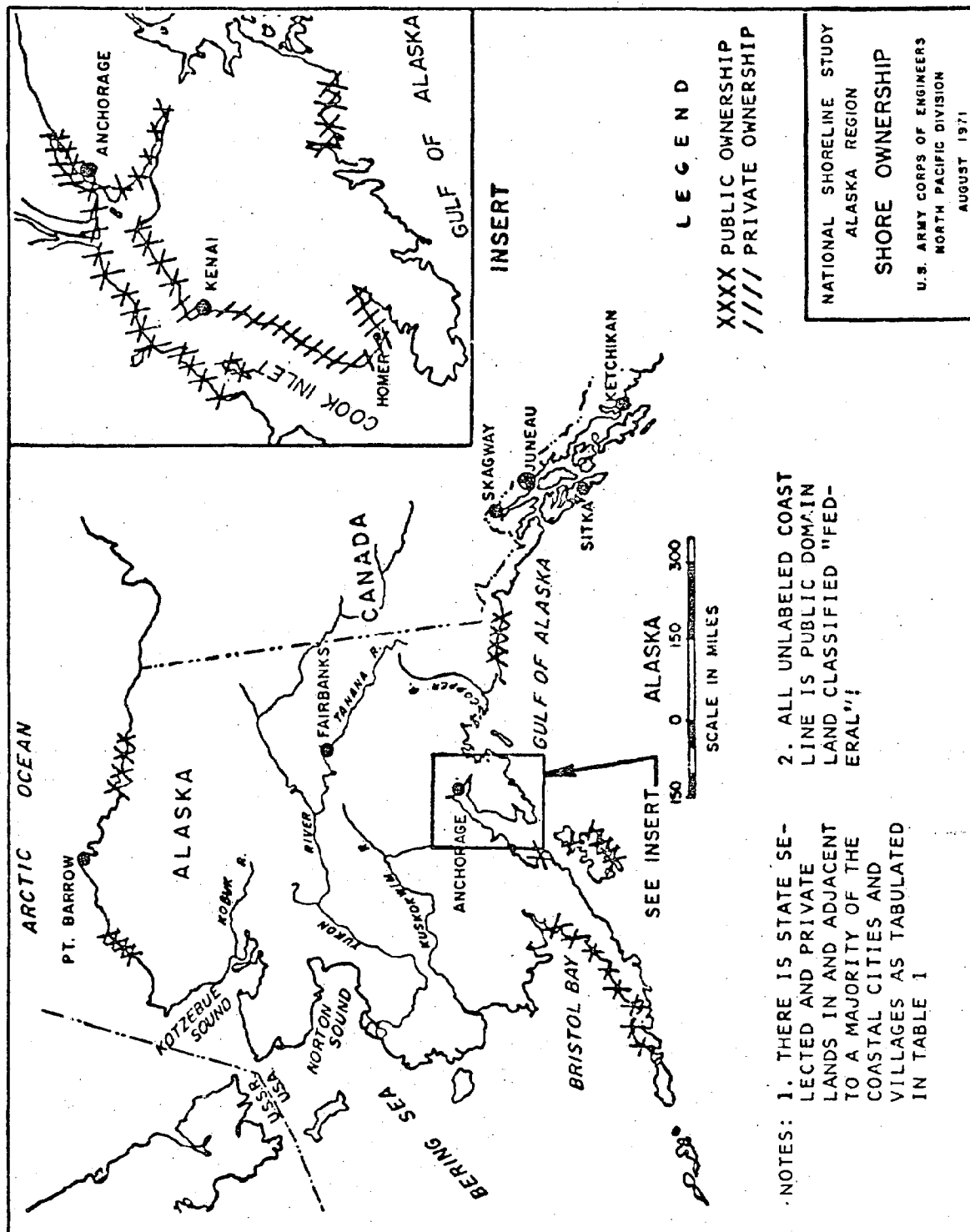
** Contacted by questionnaire

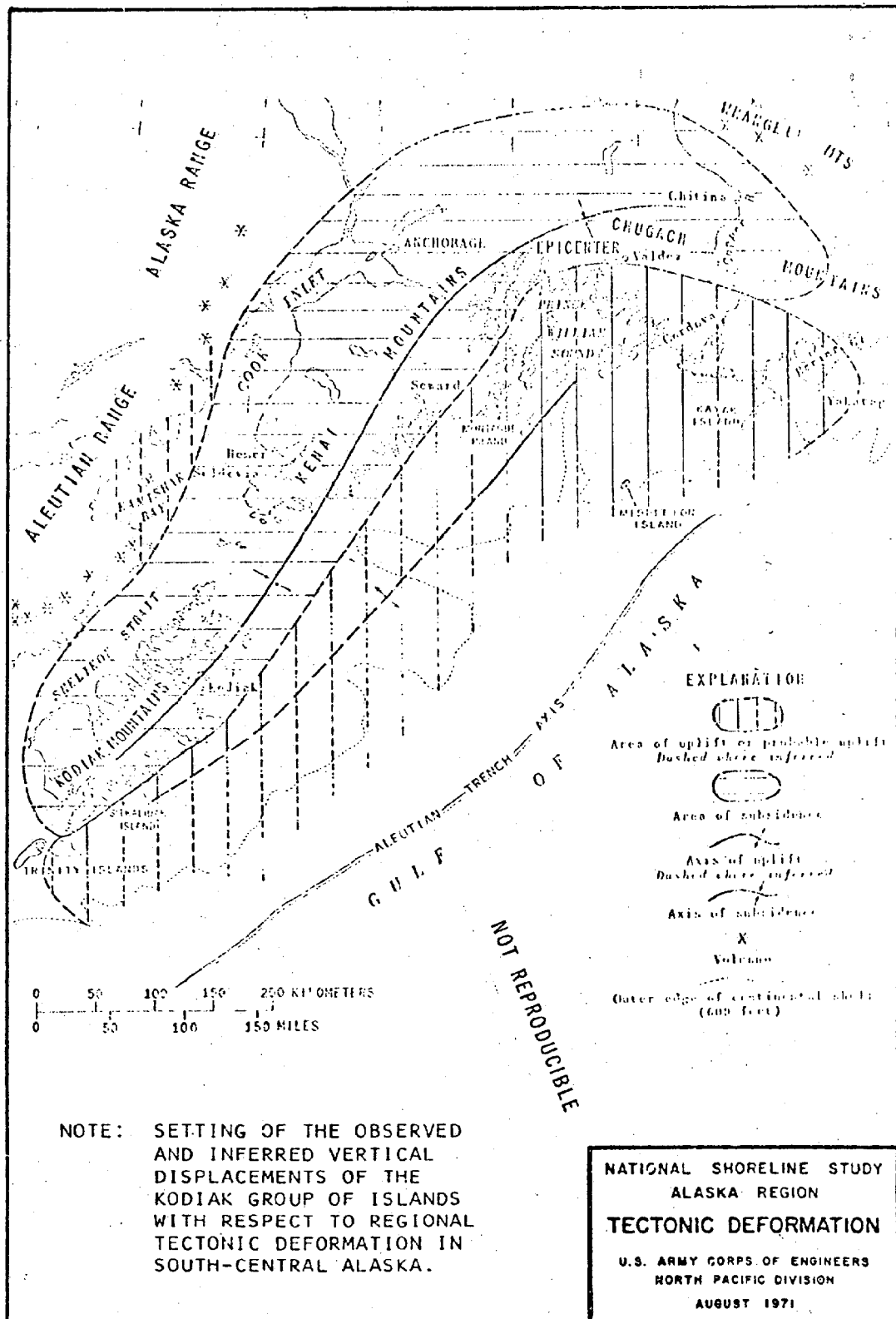
*** Located in a large State-selected (public) area

TABLE 2

	<u>UNITS - MILES</u>
I. TOTAL SHORELINE - - - - -	47,300
II. OCEAN/GULF/LAKE SHORELINE EXPOSURE - - - - -	20,250
A. *PHYSICAL CHARACTERISTICS	
1. Length of shore that normally has a beach zone -	Unknown
2. Length of shore without a beach zone - - - - -	Unknown
B. HISTORICAL SHORE CHANGES (movement of MHW line or comparable datum line)	
1. Critical shore erosion - - - - -	15
2. Noncritical shore erosion - - - - -	2,000 (est)
*3. Noneroding (stable or accreting) - - - - -	---
C. SHORE OWNERSHIP	
1. Federal - - - - -	17,650
2. Public (non-Federal) - - - - -	2,500
3. Private - - - - -	100
4. Uncertain - - - - -	0
D. SHORE USE (1970)	
1. Recreational - Public - - - - -	2
2. Recreational - Private - - - - -	0
3. Nonrecreational Development - - - - -	180
4. Undeveloped - - - - -	20,068
III. BAY*/ESTUARY SHORELINE EXPOSURE - - - - -	27,050
A. *PHYSICAL CHARACTERISTICS	
1. Length of shore that normally has a beach zone -	Unknown
2. Length of shore without a beach zone - - - - -	Unknown
B. HISTORICAL SHORE CHANGES (movement of MHW line or comparable datum line)	
1. Critical shore erosion - - - - -	80
2. Noncritical shore erosion - - - - -	3,000 (est)
3. Noneroding (stable or accreting) - - - - -	---
C. SHORE OWNERSHIP	
1. Federal - - - - -	23,700
2. Public (non-Federal) - - - - -	3,000
3. Private - - - - -	350
4. Uncertain - - - - -	0
D. SHORE USE (1970)	
1. Recreational - Public - - - - -	3
2. Recreational - Private - - - - -	0
3. Nonrecreational Development - - - - -	150
4. Undeveloped - - - - -	26,897

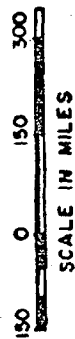
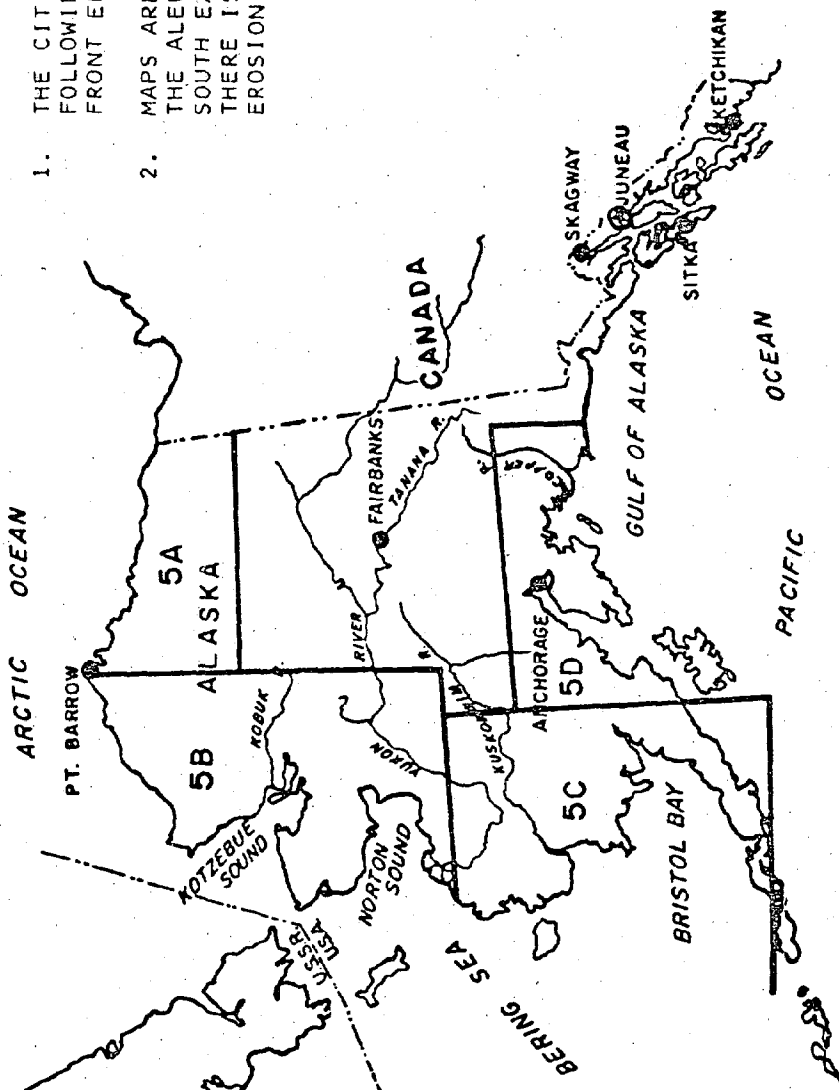
* With a large percentage of the Alaska coastline still unexplored, physical characteristics are not definable.





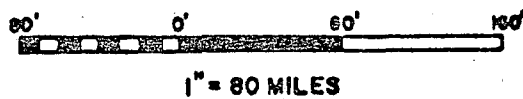
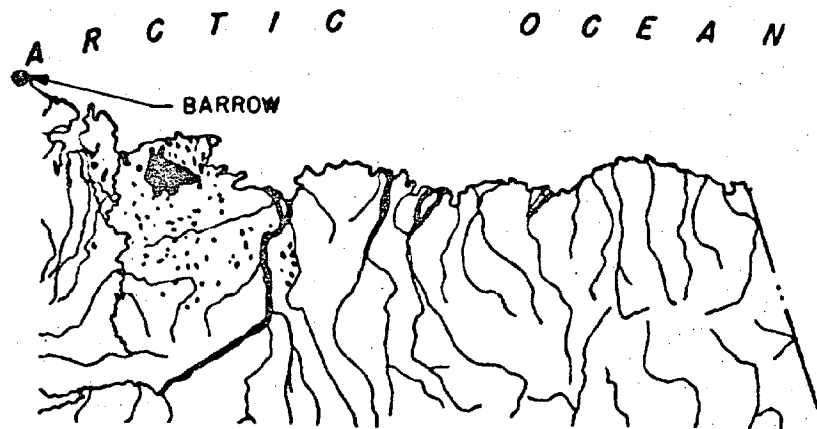
NOTES:

1. THE CITIES LISTED ON THE FOLLOWING MAPS HAVE WATER-FRONT EROSION PROBLEMS.
2. MAPS ARE NOT INCLUDED FOR THE ALEUTIAN ISLANDS OR SOUTH EASTERN ALASKA AS THERE IS NO SHORE LINE EROSION IN THESE AREAS.



NATIONAL SHORELINE STUDY
ALASKA REGION
EROSION AREAS
U.S. ARMY CORPS OF ENGINEERS
NORTH PACIFIC DIVISION
AUGUST 1971

COASTAL EROSION MAP



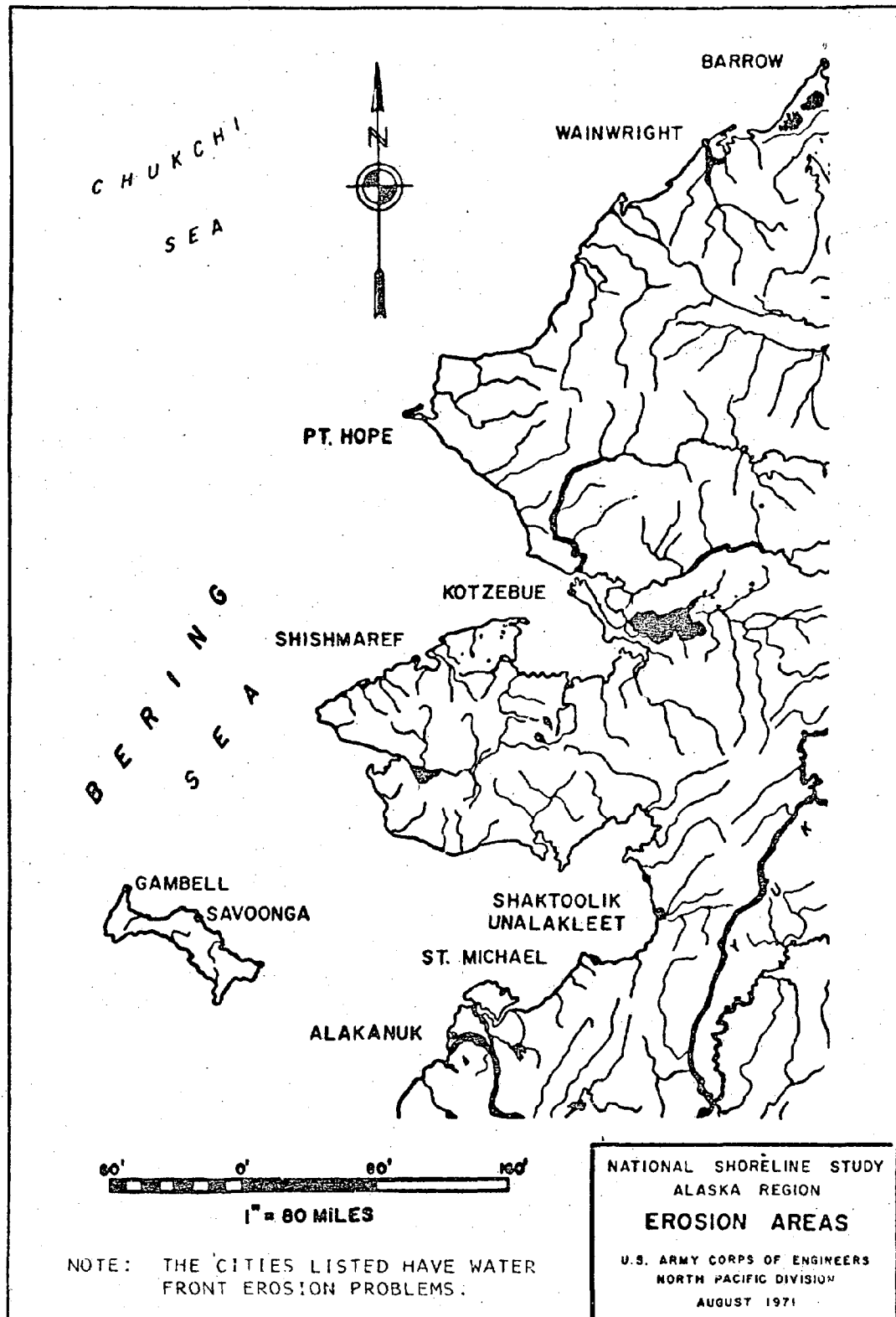
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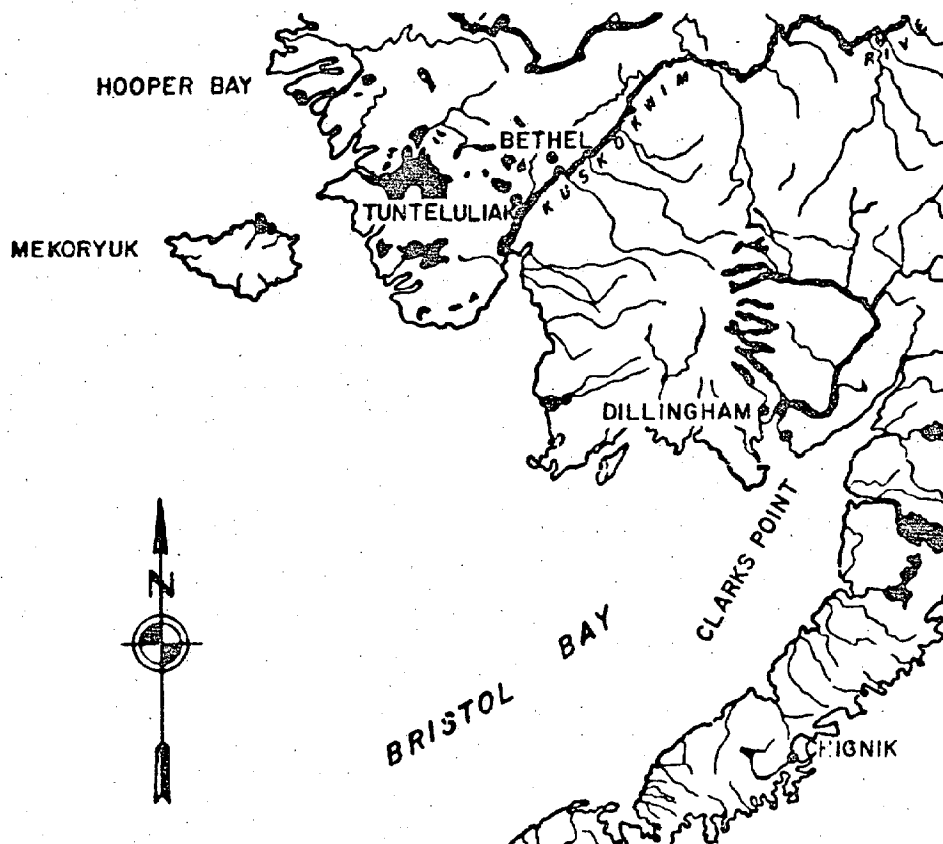
THE CITIES LISTED
HAVE WATER FRONT
EROSION PROBLEMS.

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PLATE 5A





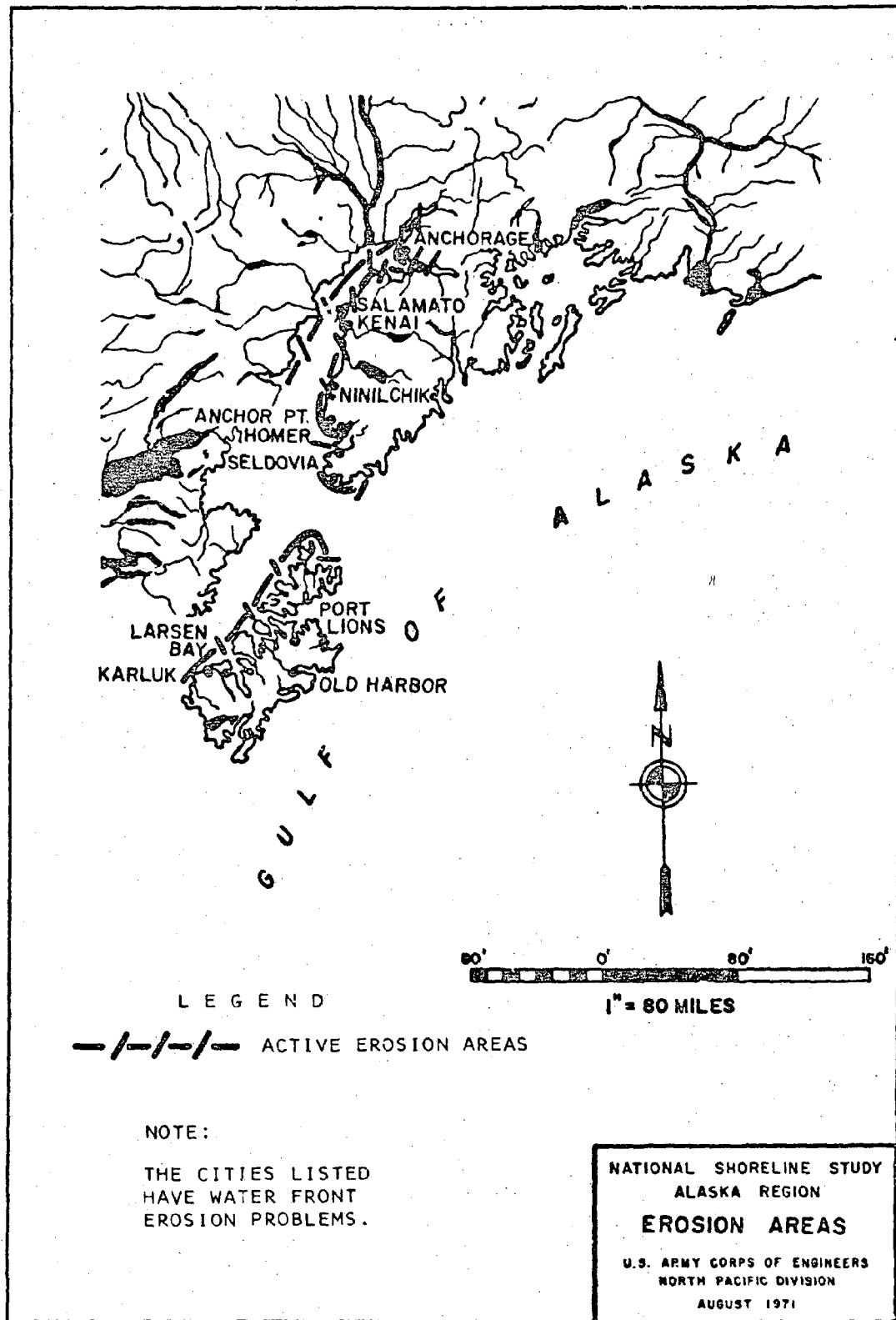
NOTE:

THE CITIES LISTED
HAVE WATER FRONT
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